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THE CLIMATE OF LIBERIA AND ITS EFFECT ON MAN

By EMORY ROSS
Disciples of Christ Congo Mission

Not the least of the pleasures of doing a bit of the more ordinary work of science in some of the tucked-away places of the earth is the fact that it has never been done before. Such a pleasure the writer has been privileged to enjoy in making a series of meteorological observations in the little-known country of Liberia.[1]

THE POPULATION OF LIBERIA

The negro is supreme in Liberia. No one of another race may own land or vote in the republic. The ruling class is made up of descendants of American negroes who colonized there and numbers not more than 20,000 or 25,000 people. The native pagan population is variously estimated; the writer's guess is that it is about 750,000. The whites living in the republic up to the time of the country's declaration of war against Germany numbered about 200. Monrovia is the capital and largest city, with a population of 8,000—in round numbers 75 whites, 3,000 Americo-Liberians, and the rest natives.

THE COAST REGION

Liberia occupies the westernmost part of Upper Guinea, fronting on the Atlantic for 300 miles with a coast line extending in a northwesterly to southeasterly direction. Along practically the whole coast is a line of lagoons, lying parallel to the sea and separated from it by sand bars from 30 to 100 yards wide. Into these lagoons, which vary in length up to 15 miles and in width from 10 to 75 yards, pour numerous small creeks and the surface run-off of a limited area inland. The lagoons empty by overflow into the sea during the rainy season, at which times the outlet remains open for a fortnight or so; but aside from this there is usually no connection with salt water. Behind the lagoons—in most cases from three to six miles back from the ocean—are numerous estuaries lying parallel to the coast for distances up to 30 miles or more and connected with the sea through the mouths of the rivers proper, which enter it at intervals of about 30 miles along the coast.

This network of coastal lagoons, estuaries, and rivers has an important bearing on the healthfulness of the best-developed section of Liberia, the coast region.

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[1] The mission board with which the writer was associated in Liberia had a broad, modern conception of its functions, and furnished simple equipment for various sorts of work outside the beaten paths of time-honored missionary endeavor. Acknowledgment is also made to friends who continued the writer's observations during periods of absence.

The flat coastal belt, diversified by occasional hills of 200 to 300 feet, has an average width of about 25 miles. It is terminated by abrupt elevations that cause rapids in all the rivers, rendering further navigation impossible and limiting the advance of civilization into the interior. Rapids are repeated, and a gradual elevation is continued, through the Liberian hinterland to the crest in the western Sudan which forms the watershed between the extreme West African coast and the Niger sources.

The coastal belt has been more or less cleared of tall forest; but, except for a small extent of savana in the north, the interior is clothed in forest that in denseness and luxuriance has been said to surpass even the forests of the northeastern Congo Basin.[2] The dense forest is an index to the climate of the country, of which, however, our direct knowledge is very limited.

The Climate

METEOROLOGICAL RECORDS

In the outstanding work on the climate of Africa,[3] the author opens the abbreviated chapter on Liberia with the remark that very little is known of the climate, and thereupon he proceeds to show convincing proof of his observation. So far as the present writer is aware, the only meteorological records in existence that have been made in Liberia over a period of more than a few weeks are those begun by himself in 1913 and ended in 1915 by Mr. Lewis A. Hurt and those made by the Deutsch-Südamerikanische Telegraphengesellschaft, A.-G., between January, 1915, and Liberia's declaration of war in 1917—both of which sets of records were available in the preparation of this paper.[4] The records were obtained at points 20 miles apart, the one set at the station of the Christian Woman's Board of Missions immediately on the coast near the town of Schiefflin (Schiefflinsville) in 6° 11′ N. latitude and 10° 33′ W. longitude, and the other at the station of the German cable company at Monrovia in 6° 19′ N. latitude and 10° 49′ W. longitude. The Monrovia station was 225 feet higher than the station at Schiefflin.

SUMMARY OF THE RECORDS

The mean annual temperature was 78.5° F. The means of the warmest month (March, 80.4°) and of the coolest months (July and August, 76.4°) were respectively but two degrees above and below the annual mean. The highest recorded shade temperature was 93°. This was reached but twice, during a hot spell in March and April, 1915. Aside from these two months, 91° was the highest temperature noted, and that point was reached but nine times during two and a half years' observations. All temperatures of 67° or lower occurred during the dry months of December, January, and February. The mean monthly range varied from 25° in January to 15° in August. The mean daily range varied from 18.4° in January to 9° in August. The smallest daily range was 3°, noted in July. Daily ranges as small as 5°, 7°, and 9° are common during the rainy months from June to September.

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[2] Sir Harry Johnston: Liberia, 2 vols., London, 1906; reference in Vol. 1, p. 8.

[3] Alexander Knox: The Climate of the Continent of Africa, Cambridge (Engl.), 1911, pp. 205, 206.

[4] A few observations for short periods of time are given by Sir Harry Johnston, *op. cit.*, Vol. 2, pp. 504-512. A summary of the records at Schiefflin for 1913-14 was given in the *Monthly Weather Rev.*, Vol. 43, 1915, pp. 178, 179.

The rainy season occupied about seven months of the year, from mid-April to mid-November. During these seven months the precipitation was 170 inches out of the annual total of 179.5 inches. With the adjoining area of southern Sierra Leone, Liberia is probably the wettest part of Africa, except for one or two isolated mountains, including Cameroons Mountain. The average number of clear days per month (less than one-third cloudy) decreased from 18 in March to 1.3 in July; the cloudy days (more than two-thirds cloudy) increased from 2 in April to 24.3 in July. June was usually the rainiest month. During the first four days of June, 1914, 20.43 inches of rain fell, and on the 16th and 17th of the same month the fall was 13.25 inches. The period of longest drought ran from December 28, 1913, to February 19, 1914—a total of 54 days, during which time 0.1 inch of rain fell on the 32nd day.

During July and August there is a period of lessened precipitation known locally as the "middle drys" and well established in the oral tradition of Liberia. It is commonly expected to begin about the last week of July and to continue till the middle of August. Table VI shows how nearly it conforms to this expectation. This suggestion of the double rainy season characteristic of the equatorial regions is in accordance with the latitude (6° 11′ N.). Farther south the double maxima are more clearly marked. The régime at Bingerville and Bassam in the Ivory Coast (5° 20′ N.) is described as very rainy in May and June, rainy in October and November, with less rain in July, August, and September.[5] Farther north, in Freetown, Sierra Leone (8° 30′ N.), there is no hint of a break in the rains, the maximum occurring as a well-defined peak in August.[6]

SENSIBLE TEMPERATURES AND INSOLATION

The sensible temperatures of the Liberian coast are not so high as those of many places in intermediate latitudes. The writer, at any rate, has never experienced in Liberia the sense of suffocation, gasping respiration, and general oppression that he has repeatedly felt in July and August in Indiana and Illinois, not to mention Mississippi. The sensible temperatures are not high, relatively, except in pockets cut off from the breeze and in places where a rocky surface formation adds its reflected heat. Monrovia has such a surface, but its elevation and the sea breeze tend to keep down the sensible temperature to levels found elsewhere.

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[5] Gaston Joseph: La Côte d'Ivoire, Paris, 1917, p. 16.

[6] Knox, *op. cit.*, p. 113.

Yet, while the heat is not so extremely and sharply oppressive during a given day or week as may be the case in other and more temperate regions, it is much more dangerous in its steady persistence (see Tables I and II), and the cumulative effect is extremely enervating. Insolation values are exceedingly high, how high one lacks data for determining. It does not require instruments, however, to give one an appreciation of the power of the sun's rays. Negligent or ignorant exposure by a European of a bare head to the sun for periods of 2, 5, 10 minutes, and the like, has resulted at once in prolonged, pernicious fevers and sometimes in death. These cases are known as a "touch of sun" and in milder forms are doubtless

TABLE I—SUMMARY OF METEOROLOGICAL OBSERVATIONS AT SCHIEFFLIN, LIBERIA, MAY, 1913, TO OCTOBER, 1915

MONTHS	TEMPERATURE (DEGREES F.)							PRECIPITATION			CLOUDINESS		
	MEAN	MEAN MAX.	MEAN MIN.	ABSOL. MAX.	ABSOL MIN.	MAX DAILY RANGE	MEAN DAILY RANGE	TOTAL INCHES	MAX. IN 24 HOURS	NO. DAYS MORE 0.01"	CLEAR	PARTLY CLOUDY 30%-70%	CLOUDY
1913													
May	**80.**	87.7	72.3	**91**	68	21	15.4	9.93	2.58	17	8	14	9
June	78.7	85.3	72.1	90	69	18	13.2	27.48	4.38	24	1	4	25
July	77.7	83.4	72.	88	68	16	11.4	30.69	6.24	**29**	**0**	0	**31**
August	77.0	81.7	72.3	86	71	14	9.4	30.07	6.16	25	3	11	17
September	**76.6**	81.7	71.6	85	68	14	10.1	23.90	3.06	26	5	9	16
October	78.6	84.7	72.6	89	70	17	12.1	24 35	4.52	26	12	14	5
November	79.6	86.6	72.5	89	70	18	14.1	8.74	2.35	15	7	17	6
December	79.9	87.8	72.	**91**	66	22	15.8	1.74	0.74	4	13	11	7
1914													
January	77.8	87.5	**68.2**	**91**	**58**	**31**	**18.7**	0.10	0.10	1	16	10	5
February	78.9	87.6	70.2	**91**	65	24	17 8	1.84	1.84	1	15	8	5
March	**80.1**	**88.2**	72.	**91**	68	21	16.2	1.29	0.48	6	18	8	5
April	79.8	87.9	71.6	**91**	70	19	16.3	8.76	2.43	14	**25**	5	**0**
May	79.4	87.3	71.6	90	69	20	15.6	19.70	3.85	23	8	22	1
June	78.	82 6	73.3	87	70	15	9.3	**50.35**	**7.50**	**29**	5	13	12
July	**75.3**	**79.3**	71.3	84	69	**12**	**8.**	13.25	3.20	23	3	6	22
August	**75.8**	80 3	71.3	85	68	17	**8.9**	14.46	2.95	20	6	9	16
September	76.8	81.6	72.1	84	69	13	9.5	26.43	3.04	**28**	6	14	10
October	78.1	83.6	72.6	87	69	14	11.	31.66	4 02	**30**	7	14	10
November	78.7	85.	72.4	88	69	17	12.6	13.90	2.50	23	12	14	4
December	79.8	**88.2**	71.5	90	**61**	**28**	16.7	4.43	2.77	8	14	15	2
1915													
January	78.7	87.8	**69.6**	90	**62**	**28**	**18.2**	0.11	0.10	2	17	10	4
February	**80.4**	**88.4**	72 3	**91**	70	19	15.4	0.38	0.14	4	12	10	6
March	**81.5**	**90.3**	72.7	**93**	70	21	17.6	2.87	0.82	7	18	6	7
April	**81.2**	**89.8**	72.6	**92**	70	21	16.8	13.53	4.20	14	8	18	4
May	**80.3**	87.3	73.4	90	71	18	14.	26.05	5.	24	6	17	8
June	78.5	83.6	73.5	87	71	15	10.1	**34.87**	**9.**	**28**	**0**	17	13
July	**76.4**	80.8	71.9	85	68	13	**8.9**	30.58	6.55	24	1	10	20
August	76.9	81.2	72.6	85	71	**11**	**8.8**	18.82	**8.20**	24	2	9	20
September	77.6	82.7	72.5	86	70	**12**	10.3	27.16	6.	**30**	2	14	14
October	79.2	85.1	73.2	88	69	18	12.	31.79	6.12	27	4	19	8

The station of the Christian Woman's Board of Missions, where the observations were made, is near Schiefflin (6°11′ N., 10°33′ W.). The instruments were exposed in a cleared space several acres in extent, 25 feet above sea level, 300 yards from the ocean, 50 feet from nearest and only adjacent building. Thermometers were in a large perforated box with double ventilated roof, 5 feet above the ground; the raingage with mouth 3 feet above the ground. The instruments were: thermometers, registered maximum and minimum, made by Taylor Instrument Companies, Rochester; raingage, Glaisher's pattern, made by Short & Mason, London. The observation hour was 5.30 P.M., Greenwich time.

Throughout the tables the mean monthly temperature is derived from the formula (mean max.+ mean min.) ÷ 2. Figures of striking significance are shown in bold-faced type.

the ultimate cause of many a run of fever that baffles the doctor both as to cure and name. A sun helmet of thick pith or cork is the common headgear and is constantly worn out of doors until 4.30 or 5 P. M., during rainy and cloudy days as well as during sunshine. There are, of course, exceptions to this rule, as to all others. An individual here and there wears an ordinary felt hat apparently with impunity, but he is the *rara avis* of the tropics.

TABLE II—SUMMARY OF METEOROLOGICAL OBSERVATIONS AT MONROVIA, LIBERIA, JANUARY, 1915, TO JULY, 1916

MONTHS	TEMPERATURE (DEGREES F.)						PRECIPITATION (INCHES)			PRESSURE (INCHES)
	MEAN	MEAN MAX.	MEAN MIN.	ABSOL. MAX.	ABSOL. MIN.	MAX. DAILY RANGE	TOTAL	MAX. IN 24 HOURS	NO. DAYS MORE 0.01 mm.	
1915										
January	78.3	84.4	72.	86.	**65 3**	**19.1**	**0.02**	0.02	1	29.91
February	79.3	84.7	74.1	87.8	71.6	14.8	**0.08**	0.05	2	29.91
March	**80.8**	**87.1**	74.5	89.8	69.8	17.1	6.36	1.82	10	29 93
April	**81.1**	**87.1**	75.2	**90.**	71.2	17.5	8.27	2 29	15	29 93
May	79.7	85.5	73.9	88.7	70.7	16.	21.13	4 50	21	29 96
June	77.7	81.7	73.8	87.1	70.3	13.3	**31.65**	5.26	**30**	**30.03**
July	**76.1**	**79.7**	72.5	84.7	68.9	**11.1**	28 95	5.36	26	**30.05**
August	**76.5**	**79.7**	73.	83.3	71.2	11.3	15 36	3.	19	**30.04**
September	77.	81.	73.	84.2	70.	13.3	**33.55**	5.18	**28**	**30.**
October	78.8	85.8	73.4	86.2	68.2	18.	29.40	**6.04**	27	29.98
November	78.6	84.2	72.9	87.4	68.2	18.	5.24	1.26	20	29 98
December	78.6	84.4	72.7	87.4	68.	18.9	1.36	1.07	6	29.96
1916										
January	78.6	84.2	73.	88.9	69.8	**19.1**	0.42	0.42	1	29.94
February	79.5	85.8	73.	87.1	68.7	18.1	**0.20**	0.23	3	29.92
March	**80.1**	85.8	74.1	88.9	69.3	17.8	2.39	0.95	7	29.91
April	79.9	85.5	74.1	88.	69.1	17.1	5.46	3.45	10	29.91
May	79.3	85.3	73.4	88.5	**66.**	**20.**	11.25	2.49	20	29 94
June	77.5	82.2	72.7	86.	69.3	14.	**35.27**	5.02	**28**	29.95
July	**75.9**	**79.7**	72.	83.3	68.	**12.8**	**42.**	5.18	23	**30.01**

Observations were made at the station of the Deutsch-Südamerikanische Telegraphengesellschaft situated on the north side of Cape Mesurado, which juts out into the sea at an elevation of 290 feet. The station itself is about 230 feet above sea level and about 100 yards from the ocean. Thermometers, maximum and minimum of standard German make; raingage, similar to Glaisher's pattern. The thermometers were exposed on the second-story veranda of one of the cable buildings, landward side, 20 feet above the ground in open air with no shelter, but were never exposed to the direct rays of the sun. The raingage was placed similarly to that at Schiefflin except in the midst of more buildings.

TABLE III—SUMMARY OF CONTEMPORARY METEOROLOGICAL OBSERVATIONS AT MONROVIA AND SCHIEFFLIN, LIBERIA, JANUARY TO OCTOBER, 1915*

MONTHS 1915	TEMPERATURE (DEGREES F.)						PRECIPITATION		
	MEAN	MEAN MAX.	MEAN MIN.	ABSOL. MAX.	ABSOL. MIN.	MAX. DAILY RANGE	TOTAL INCHES	MAX. IN 24 HOURS	NO. DAYS MORE 0.01″
January	78.5	86.1	**70 8**	88.	**63.6**	**23.5**	**0.06**	0.06	**1.5**
February	79.8	86 5	73 2	89.4	70.8	16.9	0.23	0.10	3.
March	**81.1**	**88.7**	73.6	**91.4**	69.9	19.	4.61	1.32	8.5
April	**81.1**	88.4	73.9	91.	70.6	19.2	10.90	3.24	14.5
May	80.	86.4	73 6	89.3	70.9	17.	23 59	4.75	22 5
June	78.1	82.7	73.6	87.	70 6	14.1	**33.26**	**7.13**	**29.**
July	**76.3**	80.2	72.2	84.9	68.4	12.	29 76	5.95	25.
August	76.7	80.4	72.8	84.1	71.1	**11.1**	17.09	5.60	21.5
September	77.3	81.8	72.8	85.1	70.	12.6	30.35	5.59	29.
October	79.	85 4	73.3	87.1	68.6	18.	30.59	6.08	27.

* The January-October, 1915, monthly means shown in Table I, made near Schiefflin, are added to the monthly means for the same period shown in Table II, made at Monrovia, and their sums divided by 2, to obtain Table III.

EFFECTS OF ELEVATION

Elevation above sea level markedly affects the temperature. In Freetown, Sierra Leone, 300 miles upcoast from Monrovia, the difference in mean monthly maximum temperature (1907-08) between an approximately sea-level station and a hill station 880 feet above the sea was, at a minimum, 7.6° F. (August) and, at a maximum, 10.9° (April). In a section of the northwestern hinterland of Liberia, where, so far as we have been able to learn, no white men had ever before gone, the writer's aneroid registered

TABLE IV—TEMPERATURE MEANS, MONROVIA AND SCHIEFFLIN, LIBERIA, FROM THREE YEARS' OBSERVATIONS*

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Mean...............	78.3	79.3	**80.4**	80.2	79.8	78.2	**76.4**	**76.4**	76.9	78.7	78.9	79.4	78.57
Mean maximum....	85.9	86.6	**87.6**	87.3	87.1	83.5	81.	**80.8**	81.7	84.6	85.3	86.8	84.85
Mean minimum....	**70.7**	72.1	73.2	73.2	72.5	73.	71.8	72.1	72.2	72.8	72.6	72.1	72.36
Mean daily range..	**18.4**	16.6	16.9	16.5	15.	10.9	9.4	**9.**	10.	11.7	13.3	16.2	13 65
Monthly range.....	**25.**	21.	21.	20.	21.	18.	17.	**15.**	16.	18.	19.	24.	19.58

* Compiled: May, 1913, to Dec., 1914, from Table I; Jan., 1915, to Oct., 1915, from Table III; Nov., 1915, to Apr., 1916, from Table II.

The mean daily range is compiled from Table I only. The monthly range is the mean of the difference between the absolute maximum and absolute minimum.

TABLE V—PRECIPITATION AND CLOUDINESS MEANS, MONROVIA AND SCHIEFFLIN, LIBERIA*

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Mean rainfall (inches)	**0.19**	0.76	2.76	8.37	17.74	**37.03**	24.57	20.54	26 89	28.87	9.29	2.51	179.5
Mean no. of days with more than .01".....	**1.7**	2.3	7.2	12.8	20.8	**27.3**	25.7	22.2	**27.7**	**27.7**	19.3	6.	200.7
Mean no. of clear days	16.5	13.5	**18.**	16.5	7.3	2.	**1.3**	3.7	4.3	7.7	9.5	13.5	113.8
Mean no. of partly cloudy days........	10.	9.	7.	11.5	17.7	11.3	5.3	9.7	12.3	15.7	15.5	13.	138.
Mean no. of cloudy days................	4.5	5.5	6.	**2.**	6.	16.7	**24.3**	17.7	13 3	7.7	5.	4.5	113.2

* Sources as in Table IV. Cloudiness is compiled from Table I only. Clear day has less than one-third, partly cloudy from one-third to two-thirds, and cloudy more than two-thirds of sky obscured by clouds.

TABLE VI—DIMINUTION OF PRECIPITATION DURING THE "MIDDLE-DRY" SEASON, SCHIEFFLIN, LIBERIA

DATE		NO. OF DAYS IN PERIOD	NO. OF DAYS OF RAIN DURING PERIOD	PERCENTAGES OF DAYS OF RAIN DURING PERIOD	TOTAL RAINFALL	MEAN DAILY RAINFALL
BEGIN	END				INCHES	
1913						
July 1	July 24	24	22	92	30.02	1.25
July 25	**Aug. 14**	21	16	**76**	**4.3**	**0.2**
Aug. 15	Aug. 31	17	16	94	26.54	1.56
1914						
July 1	July 7	7	5	71	5.99	0.85
July 8	**Aug. 15**	39	24	**62**	**8.52**	**0.22**
Aug. 16	Aug. 31	16	15	94	13.20	0.82
1915						
July 1	Aug. 1	32	25	78	33.48	1.05
Aug. 2	**Aug. 26**	25	18	**72**	**6 40**	**0.25**
Aug. 27	Aug. 31	5	5	100	9.52	1.90

1,950 feet before an accident in the hands of an unsuspecting porter rendered it useless for the rest of the journey. At that elevation and at the height of the dry hot season, we traveled on foot day after day without undue loss of strength, the expedition ending its three-months' journey by a forced march of 225 miles through dense forest and over fearful paths in nine successive days, an average of 25 miles a day. Such a record as that we have never been able to approach on the low-lying coastal plain, but we have experienced similar beneficial effects of altitude on physical endurance in the savanas of the Ubangi basin of Central Africa. The desirability of getting up above the sea is so immediately apparent that the first Europeans to settle the coast built their houses on the tops of hills, wherever such locations offered, and thereby dearly purchased the experience that later arrivals have had as a guide. For the hilltops, while

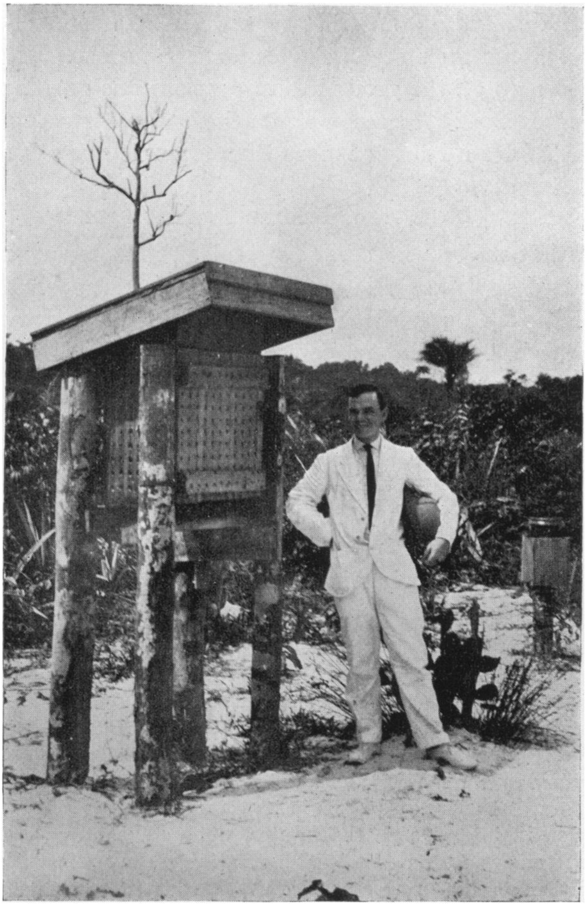

FIG. 1—The author, thermometer shelter, and raingage at the station of the Christian Woman's Board of Missions, Schiefflin, Liberia.

most agreeably cool, were too exposed to every wind that blew to be healthful; chills, fever, congestion, dysentery, death follow the winds to the tops of hills. Houses built later are perched on the sides of hills in some protected spot where the benefits of elevation may be had without its most conspicuously attendant evil. The desire to get up above things along the swampy West Coast is so strong that most Europeans prefer to climb stairs to living, dining, and sleeping rooms on the second and third floors rather than remain on the more easily attained first floor. This tendency of Europeans to live up off the ground disappears as one gets into the interior of the continent where the surface elevations above sea level are higher, and in Central Africa a house of more than a single story is exceptional.

THE WINDS AS A FACTOR IN HABITABILITY

The factor that makes the coast as good as it is for white men is the winds. Day after day the sea breeze blows, and night after night the land breeze goes back out to sea. Morning comes, and the shift again is made; while during the lull that intervenes around 8 or 9 o'clock each morning, as the land breeze trades itself for the wind from the sea, one has a taste of what life might be there without the winds. Fortunately periods of complete calm are rare, and one has only discreetly to place oneself in the breeze to be cool. During the northern summer, when an area of low pressure obtains over the Sahara, the dominant wind of the West Coast is the moisture-laden southwest monsoon. The winter months are characterized by the *harmattan,* blowing intermittently from the northeast. Knox writes of this wind:[7]

> The Harmattan is experienced as a wind which blows, especially in the months of December, January, and February, from the N.E. and is a hot wind in some localities and a cold wind in others, according to circumstances. During this season, in the actual coast districts, it alternates with the land breezes, which blow from midnight till about sunrise, chiefly from the N.W. As a general rule the Harmattan begins early in the morning and falls off towards midday. Dried by its passage over the warm sands of the Sahara, it brings sandstorms in its course. Under its influence the lagoons of the coast region rapidly give up their water, while stagnant waters disappear altogether, as, except perhaps for an occasional storm, it does not rain during the Harmattan period. Further, in the process of this evaporation, it gives up a large amount of heat and is thus rendered a comparatively cool wind. The Harmattan generally gives place to sea breezes from the S.W., while land and sea breezes alternate during the remainder of the year.

One may say that the nights are always cool. No sooner has the sun dropped to within an hour or so of the western horizon than every living thing seems to find at least some small relief from the severe conditions of the preceding ten hours. The birds, silent since 10 or 11 o'clock in the morning, begin to sing; the wild life of the forest bestirs itself, and feeding and drinking begin again around the common water holes; the native appears more numerously in the open spaces of the towns and *fakais,* and preparations are made for the one ceremonial meal of the day, which is eaten in the evening, and for the strenuous activity of the play or the dance that may quite likely follow when darkness falls. The European, wise in following the example of native life about him, closes his factory or leaves his mission work or government office and goes out for a stroll or a horseback ride or a game of tennis. Evening is the social time *par excellence* of the tropics. The cool nights are second in importance to the winds in making the African West Coast habitable for Europeans. Sleep and rest, as far as nocturnal climatic conditions can control them, may be had perfectly. The writer does not recall a night spent in Liberia under less than one blanket, while frequently two or three were needed. The early morning, before 6.30, is mildly fresh but not enough so to invigorate one perceptibly. Between 7 and 9 A. M. there is likely to be a "muggy" period of calm, oftentimes the most unpleasant part of the day, while the land breeze is dying away and the sea breeze is getting its daily start. From 11 to 2 o'clock is the time one may expect to "have a head" if a "touch of sun" has previously been experienced, for during that period the total effect of the sun is so great as to make itself unpleasantly felt even in the best-constructed houses the writer has seen. It is during a part of this period that the siesta is taken. At 4.30 or 5 the evening's coolness has come again, and one is passively content in the thought of having lived through another day.

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[7] *Ibid.*, pp. 92-93. The character of the *harmattan* in the hinterland of the Guinea coast is discussed by H. W. Braby, *Quart. Journ. Royal Meteorol. Soc.*, Vol. 39, 1913, pp. 301-306.

A Region of High Humidity

Humidity data for Liberia are not available, but for Freetown (Sierra Leone) the mean annual relative humidity is 79.4 per cent, the highest being 84.6 per cent in September and the lowest 74.2 per cent in March. For Grand Bassam, on the Ivory Coast, about 500 miles downcoast from Monrovia, the mean relative humidity for the year (1904 and 1905) is 87 per cent, the highest being 90.1 per cent in June, July, August, and September and the lowest 83 per cent in January. Somewhere between conditions in Sierra Leone and those in Grand Bassam may be found the humidity of Liberia. One may safely say that it is very high; certainly as great as in Sierra Leone but probably not so extraordinarily high as in Grand Bassam.

During the dry season the rainfall is negligible; but moisture is supplied to the plant life by the excessive dews that in many cases are equivalent to light showers. The very heaviest dews come during the early part of the dry season, but they are never absent. Frequently, under the eaves of the corrugated iron roofs of our station buildings, there would be in the morning lines of heavily splashed sand where the dew had poured off the roofs in the night. Every leaf and blade of grass in sight would sparkle in the morning sun while it drooped under the weight of the dew it bore. A native custom not without its amusing side is that of sending a little naked boy ahead through the path which his elders must travel early in the morning, that his body may shake as much dew as possible off the grass and brush which closely borders every path and enable those who follow to pass through dry-shod, as it were. A distinct fall in temperature is not necessary to produce dew. The air is so nearly saturated with moisture that the slightest drop of the thermometer precipitates an appreciable amount. It is only by the moisture thus received that plant life is enabled to remain as green as it does during the blistering heat of the dry season.

The Rainy Season

The storms that usher in the rains come suddenly and usually from the southwest. They terminate as suddenly as they begin. Within an hour a terrific blow and a sharp downpour may have been conjured up out of nothing in the southwest and have passed out of sight to the north or northeast. The first storms of a new rainy season occur usually at night, getting gradually later in their appearance until they have introduced the real daytime rains of the season. Then storms practically cease, and the serious business of pouring water on the earth begins. There is little of the spectacular or boisterous about the rainy season proper; there is a common absence of wind, of thunder, of lightning, of pyrotechnics of all sorts; the rain simply falls—falls steadily and rather quietly for days and weeks and months, and then, in a burst of curt, furious storms, as at its beginning, it stops, and the sun and wind begin their task of lapping up this torrential fall of useless water.

The season of rains is probably the most pleasant one for Europeans. There are a few days during that season when the feeling is one of ''stickiness'' and great oppression, but such days are not common. The daily temperature range is from 3° to 10° F. A fire in an open grate, if a grate has been built into a house, as is infrequently the case, is a rather happy thing; its genial effect is more in drying out the house than in directly furnishing warmth. The natives are often sufferers from cold on rainy days and sit around the little fires that are kept eternally going within their mud-walled houses. When they find it necessary to travel or work out of doors in an actual rainfall, it is a common practice for them to remove even the scanty cloth they at other times wear, to prevent the chilling of their bodies that would come from the evaporation by the wind of the cloth's moisture as they move about. They think it a strange thing that a white man, instead of reducing the amount of his clothing under those circumstances, should augment it by the addition of a raincoat and a waterproof helmet cover and maybe gloves and gum boots.

During the midst of the rains there is no stagnant water, and mosquitoes are scarce. The weeks at the beginning and particularly at the end of the rainy season are the most unhealthful. At the latter time the earth is filled to overflowing with water, and, as the higher areas dry out, the water, caught in pockets and depressions, big and little, and protected by dense foliage above, furnishes the very best sort of birthplace for the germs and the animal life that acts as hosts and transmitters of these germs, and they soon are seriously attacking the human inhabitants of the region.

INFLUENCE OF THE RAINS ON HUMAN LIFE

The rains have an important influence on the life of the country in relation to travel, transportation, communication, and food supply. The wet season largely determines the time for traveling and the means of locomotion. Natives having visits to pay to distant parts plan to go during the dry season. White officials or traders try to make the necessary tours of their posts during these months. Missionaries know it is best to plan their work so that the special activities of the base station may be developed during the rains, leaving the rest of the year for extensive itineration. It is not always possible to do these things, but the rains cause one to try. Toward the end of the wet season, also, many small rivers are made navigable, and the navigable stretches of the larger waterways are increased, so that, for some time after the rains have ceased, water communication is still possible with points that later in the dry season can only be reached overland and by a much greater expenditure of effort, time, and

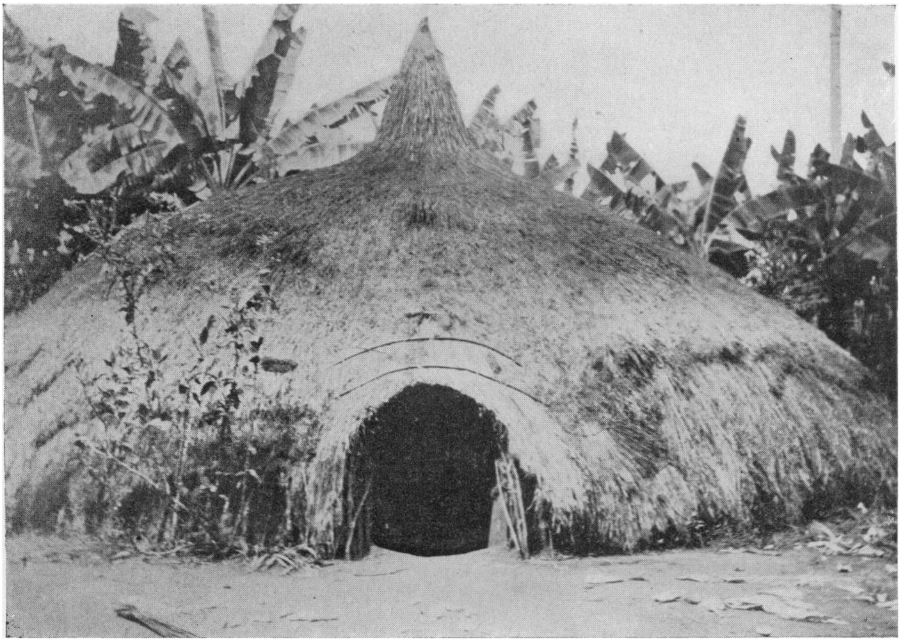

FIG. 2—Native architecture, adapted to the heavy rainfall. The thick thatch roof is brought practically to the ground as a protection to the mud walls.

money. When water communication is cut off, transportation to such points is usually on the heads of native porters. This is expensive. On the basis that an average porter carries 60 pounds 15 miles a day for 25 cents, the ton-mile cost of this means of transportation is over 55 cents—a charge that ordinarily prohibits transportation from a locality very far distant from a waterway.

An interesting illustration of the effect of the rainy season on food supply is a custom in vogue before imported salt was available. During the dry season each large town in the Liberian hinterland used to send a delegation down to the coast, 250 miles away, to "cook salt," as they phrased it, from the sea water in sufficient quantities to last the town until the succeeding dry season.

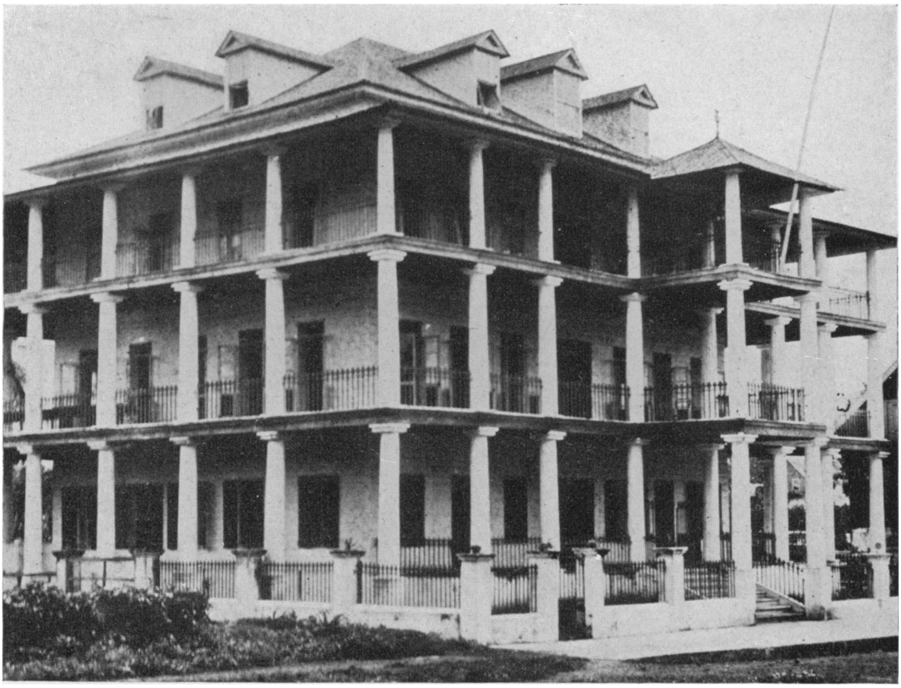

Fig. 3—Americo-Liberian architecture. Executive Mansion and home of the President of the Republic of Liberia at Monrovia.

The rains fill swamps, flood paths, wash away bridges, bring rivers out of their banks, sometimes in twelve hours or less, and in general upset the scheme of life worked out for the dry season. The rains have a direct effect on the style of native architecture. The houses, being of mud, are necessarily low and squat and of cramped dimensions so that a thick thatch roof of but medium size and within the power of one man, or of two or three, to make and to renew, will adequately cover it almost down to the ground all around and thus protect the mud walls from the soaking and disintegrating rains. Only the chiefs can afford the labor necessary to thatch and re-thatch, every second or third year, a really roomy house.

EUROPEAN LIFE ON THE WEST COAST

We may turn now to some considerations especially touching the life of Europeans in Liberia and, by extension, along the West Coast in general. Houses for white men are commonly elevated on pillars two to six feet above the ground. The upper stories are used as the living quarters. The material of which buildings are constructed is usually corrugated galvanized iron, although concrete, stone, and brick are growing in favor and will continue to do so. Wood is scarcely ever used except for the necessary framing, both because prepared timbers and planks are expensive and difficult to get and because the most kinds of wood are little else than food for the misnamed ravager known as the white ant—in truth neither white nor ant. Railroads and telegraph and telephone lines were at first very hard to maintain because of these same termites, which have long since forced the use of steel for ties and poles along the right of way.

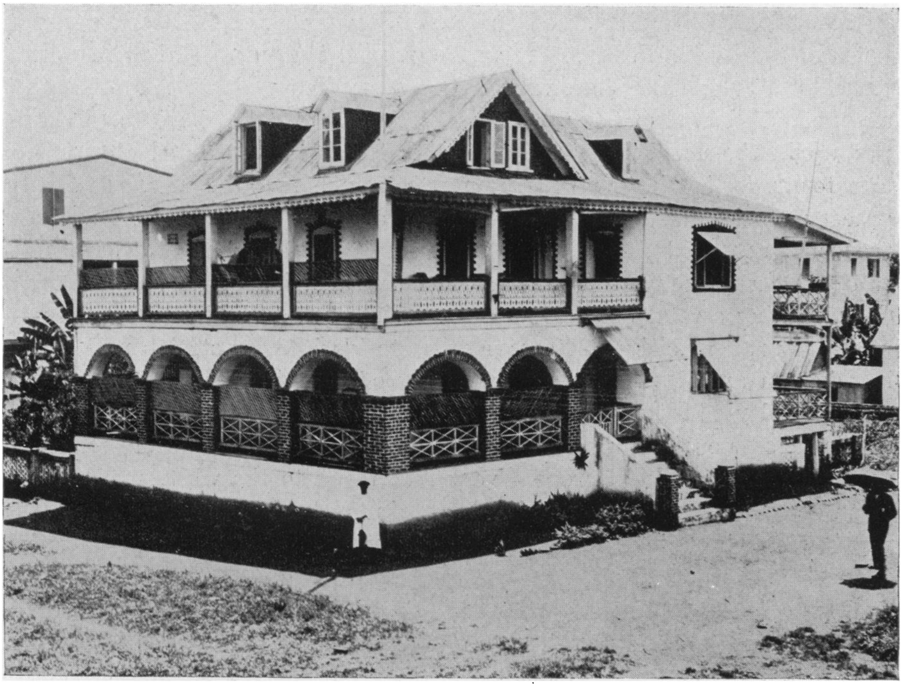

FIG. 4—Americo-Liberian architecture. United States Legation, Monrovia, Liberia.

Climatic conditions largely determine the foods the European shall eat, both imported and local. The latter are limited to what the native knows how to raise for himself or what the European has the time and knowledge to attempt to raise, and in both cases the climate has set a limit. This limit permits the raising of some few sorts of foods to which the European has become accustomed in his home country but prohibits the raising of a good half or more of such foods. Rice, bananas, plantains, palm oil, sugar cane, manioc, breadfruit, coffee, coconuts, nubbins of corn, and greens of various sorts about make up the native vegetable diet. The European or Americo-Liberian may add beans, carrots, watermelons, turnips, better corn, more kinds of greens, and maybe a few other articles if he has luck. But the staples which form his diet at home must be imported—potatoes, sugar, flour, oats, milk, butter, salt, cheese, tart fruits; and all those except potatoes must be put up in tins carefully and with special reference to hot and humid conditions. Sugar, flour, salt, etc., were tinned in normal times by a large New York wholesale grocery house at the rate of 4 cents a pound. A barrel of flour costing $7 originally would be worth $15 when put up in the usual seven-pound tins, before it even started on the long trip to its destination, expensive enough even before the war. In 1918 a grocery consignment invoiced at $700 by a Chicago mail order house cost the consignee, laid down at his West African coast port, in charges for rail and ocean freight and marine and war-risk insurance, an additional $750, making a total of $1,450 for the order—and it had still to be transported by rail and river 900 more miles to his interior station and to pay in addition an ad valorem customs duty of 12½ per cent. The expense and difficulty of securing imported foodstuffs, even in times of peace, and the lessened nourishment contained in preserved tinned goods, make the climatic control of local crops a very real thing to the white man. He is often compelled to rely so absolutely on tinned food that one of the native pidgin-English equivalents for the phrase "to prepare a meal" is "to kill a tin"!

Tropical Hygiene

Personal hygiene in the tropics is a rather different and more painstaking matter than in the native home of the white man. In the humid tropics the white man cannot do sustained manual labor. Knowledge of that fact has attained the standing of a maxim on the West Coast, and if any further proof were needed it would be furnished by the evident inefficiency of the brave and willing European and South African troops of the line in the various tropical African campaigns of the war, as compared with the unremitting service rendered by the native soldiers drawn from Senegal, Nigeria, the Belgian Congo, and East Africa. Houses for white men have to be well screened with fine-mesh wire, and an equally fine-mesh mosquito tent covers every bed. Woolen blankets and light woolen underwear for those whose skin is not thereby irritated are proper things to have. To eat oftener and less heartily than in the homeland, is probably a good rule. Exercise is absolutely necessary, no matter how contrary it may be to one's inclination. All men qualified to discuss the matter agree that even moderate alcoholic indulgence is a wholly bad thing in the tropics. The red blood corpuscles are measurably thinned out, partly by the decreased supply of oxygen that the respiratory system gets; and this anaemic tendency is aggravated by malaria and by quinine—both by the disease and its specific, since malaria and quinine each tend to destroy the red cells.

Malaria and dysentery are endemic; yellow fever, plague, cholera, and smallpox have not occurred in Liberia for years. Sleeping sickness and the species of tsetse fly that is believed to carry this disease are both present in the republic, the fly in great quantities along its usual haunts, the river banks; but of sleeping sickness itself there have been only half-a-dozen instances in as many years. Europeans are rarely affected by the trypanosome in any case. Haematuric, or black-water, fever, following long-continued attacks of malaria, is probably the most dreaded of West Coast ills. Quinine has attained almost to the rank of a food on the West Coast; practically every European dining table has its bottle of the drug, and guests are offered one of the bitter tablets as a matter of course. Ordinarily a white man takes five grains a day as a prophylactic measure. In case of actual fever the dose is increased. The writer administered as much as 46 grains in 20 hours to a fever victim, but that was probably an excessive dose.

Dysentery must always be guarded against; a condition of perspiration, followed by injudicious cooling in a breeze and a consequent chilling of the abdomen, are the external circumstances that especially favor dysentery. Some Europeans, for the protection of the abdomen from chills, are compelled to wear a cummerbund—several feet of wide woolen belting wound around the body. The few European children on the coast appear to do fairly well for the short time they are there, but one may be sure that every season a child spends on the West Coast will be at the later cost of vitality that may handicap him for life. The various sorts of intestinal worms affect children greatly. European women do not withstand coast conditions as well as do men. Their more sensitive nervous system is particularly likely to be affected.

The Nervous Strain of the Tropics

This matter of nervous and mental make-up brings us to the final consideration of this paper. Along with the trying conditions of climate and disease go a host of pests and constant recurrences of life's little irritations. Moths eat up clothing; cockroaches devour bookbindings and nest in the cookhouse; rats climb to impossible locations and leave nothing but the fragments of what they have eaten there; white ants consume the sills of houses and the rungs of chairs; driver ants sweep through the house, and every other living creature therein must vacate, from the lord and master down to the lurking lizard, even if it be in the dead of night or the midst of rain; jiggers bore in under the skin of the foot and lay their eggs; fleas bite; the heat produces rash against which the lightest clothing feels like nettles; dhobie's itch makes its appearance and acts as if it had taken up its permanent residence. These things and the proverbial one thousand and one others like them are real and irritating at any time, but through the blur of a "touch of sun" or the haze of a burning fever they assume proportions out of all reason. The odors, the mists, the sights, the sounds get on the nerves; the heavy, drooping, silent, impenetrable green forest everywhere shuts one in like a smothering grave; the mind grows sick, and the body follows. For these reasons, largely mental, no one should stay on the West Coast longer than eighteen months at a time.

The writer has cited many things in this paper that do not bear directly on climate, in an attempt to point out a few of the influences that, connected with an unusual and inhospitable climate, combine to make acclimatization at present all but impossible. His feeling is that, if the earth's increasing population makes the acquisition of additional cultivated land areas of sufficient importance to justify the immense efforts that would be necessary for the sanitation of tropical countries, acclimatization of the white man to those countries would be possible. This means, of course, that the present bar to such acclimatization is mainly disease rather than climate. At present the relation of whites to the African West Coast can only be one of tolerance.